

FRACTURES OF THE SKULL FROM A NEUROLOGICAL STANDPOINT

BY GEORGE D. ROBINS, M.D.

Neurologist to the Western Hospital

IT is necessary to confess at the outset that there are no neurological phenomena pathognomonic of fracture of the skull. The nervous symptoms that accompany fracture of the skull are not in essence due to that fracture, but result from injury to the intracranial contents and may be brought about by other lesions than a broken skull—any severe blow on the head, for example.

Such a blow on the cranium produces what we call concussion. It temporarily squeezes or crushes the brain. An animal's brain may be seen to be squeezed out into a trephine opening made for purposes of observation, if a blow is struck on the opposite side of its skull. Owing largely to the fact that the brain rests on a water cushion formed by the cerebro-spinal fluid, this compressing force affects the whole brain and not merely the site of the blow. The resulting rise of intracranial pressure tends to squeeze out the fluid contents of the skull and interferes for the time with the intracranial circulation. This interference with the cerebral circulation, combined with the effects produced upon the cells comprising the various nerve centres, is probably responsible for the initial symptoms of concussion, symptoms which vary greatly in intensity.

In the mildest cases there are transient giddiness, headache, flashes of light and ringing in the ears. In cases of moderate severity there are added to the above symptoms flaccidity of all the muscles and rapid unconsciousness, shallow breathing and weak pulse, followed perhaps by brief incoherence as consciousness returns, also complaint of headache, giddiness and tinnitus, an unsteady gait and a sense of fatigue.

In the more severe cases of concussion, to which a majority of the cases of fracture of the skull belong, there is sudden and profound unconsciousness, with great pallor, muscular relaxation and loss of reflexes, even, it may be, that of the pupils to light. Probably in the earliest stages the patient is pulseless and does not breathe, while wounds do not bleed. This very brief preliminary

stage is rarely to be seen by a skilled observer. The pulse returns, weak and irregular at first, and shallow, irregular breathing is established. The blood pressure is low.

Many of the fatal cases of fracture of the skull never rally from the shock of this first stage.

Our experience at the Western Hospital is that the struggle in what prove to be the fatal cases of fracture of the skull is apt to be a short one, for of sixty fatal cases in the hospital records forty-five (or 75 per cent.) died on the day of the accident or the day following.

But in most of these fatal cases as well as in cases that recover, the bulbar centres (vasomotor, cardiac, and respiratory), stimulated by their anæmic condition, are urged to greater effort. Through vagus stimulation the heart becomes slower and stronger, respiration becomes deeper and stertorous, though often irregular or of Cheyne-Stokes type, and through action of the vasomotor centre upon vasomotor nerves the blood vessels contract. All this results in a rise of blood pressure considerably above normal.

The deep reflexes return and are frequently quite active. The patient begins to move and moans a little. Consciousness returns gradually. The patient is apt to be irrational for a time and is very irritable, often noisy, and strongly resents being examined or disturbed in any way.

Careful examination of the nervous system is necessary, in order that no localizing symptom may be overlooked—prolonged and profound mental disturbance in lesions of the frontal lobe, motor paralysis or Jacksonian attacks in Rolandic lesions, hemianopia in occipital lobe lesions, paralysis of the various cranial nerves. Sensory symptoms do not seem to be common and are hard to make out, owing to the patient's mental condition, but I have noticed some astereognosis in one or two cases.

But it is important to remember that such localizing lesions may be due to a focal inflammatory cedema, as well as to hæmorrhage or to bony pressure. I well remember the case of a young man who, after receiving a very severe blow on the left side of the head, followed by headache, loss of power to do his usual mental work and a marked rise of blood pressure, developed a decided weakness of his right arm. I was tempted to advise operation, but the negative finding on lumbar puncture led to a policy of watchful waiting which the event justified, for the weakness soon disappeared spontaneously.

Perhaps the commonest focal sign of value is the presence of

a Babinski. The existence of dorsal flexion of the great toe on tickling the sole of the foot should be regarded with suspicion, even if present but for a short time.

It is remarkable how trifling may be the injury which will occasionally fracture a skull. For example, an Italian was taking down from a scaffold a board which he could readily reach from the ground. The end of the board, slipping, fell a distance of not more than eighteen inches, striking him on the head and knocking him down. He was brought to the Western Hospital and was quite conscious on admission, but soon became drowsy. When I saw him a couple of hours after admission, he had a one-sided Babinski and could hardly be roused. The lumbar puncture showed blood in the cerebro-spinal fluid. Immediate preparation was made for operation, but before this could be done, he stopped breathing. Fortunately a few artificial respirations and a large hypodermic of strychnine and atropine started him breathing again, and the operation was completed by Dr. Springle. The skull in the temporal region, which was of almost egg-shell thinness, was fractured. A large quantity of clot and semi-fluid blood was removed, partly intradural, but mainly of middle meningeal origin. Two days later the man was sitting up in bed calling for his dinner and he recovered completely.

Lumbar puncture in cases of suspected intracranial traumatism should always be resorted to. The presence (and the amount) of blood in the cerebro-spinal fluid and the increased tension the fluid is generally under are important guides to treatment. It is of some advantage to know the percentage of blood contained in the fluid withdrawn, and where the time necessary to do a cell count is lacking, a quicker approximate estimate may be made by measuring the hæmoglobin in the cerebro-spinal fluid and comparing this with the percentage of hæmoglobin in the patient's blood.

As to *Prognosis*, recovery is gradual and tedious. In most cases giddiness, more or less vasomotor instability, headache and inability to do as much physical or mental work as before the accident, are symptoms that last for months.

Our experience at the Western Hospital would seem to show that the danger to life is soon over in the majority of cases. Only ten of our sixty fatal cases lived more than three days, and but three lived more than five days after the accident. It is to be remembered in this connexion, however, that in a large proportion of our cases the violence of the blow was very great (tramway or railway accidents).

Dr. England tells me that in a general way it is his experience that, provided a case of fractured skull does not die as a direct result of the injury, those cases do best where the bone is severely crushed and the membranes and even the brain substance are badly lacerated—possibly because such cases are sure of good drainage. He refers to the cases of an old man and his wife, both struck by a street car some years ago. The man had only a dislocated clavicle and a lacerated hand. He died. His wife arrived at the Western Hospital with her head smashed in, very pale, with sighing breathing, apparently moribund. Pieces of bone were removed from as deep as the ventricles. The confident prediction was made that she could not live through the night, but she was conscious next day and made an uninterrupted recovery, complete except for a hemiplegia due to destruction of the motor area.

Dr. Springle has a similar case showing to what an extraordinary extent the brain may be damaged and recovery occur. A tramway trolley was pulled from its wire, so that the pole flew into the air, throwing off the end, weighing some twelve pounds. This fell on the head of a boy of nineteen, crushing in the vault of the skull. He was brought to the Western Hospital "in a dying condition", to quote the note made on his admission, brain, scalp and skull being intermixed in a horrid mess. Forceps had to be left for days in his brain as deep as the lateral ventricle, to control hæmorrhage. He recovered and two or three years later when examined for medico-legal purposes he had no paralysis whatever.

Bigelow's case of a man of twenty-five who had a crow-bar three feet seven inches long and one and one-quarter inches in diameter blown completely through his head, entering below the left zygoma and passing out near the coronal suture close to the middle line, reported in 1850, is still a most remarkable case, for the man was able to sit up and converse almost immediately after the accident and recovered completely except for blindness of his left eye.

Our Western Hospital statistics seem to show that women, though much less liable to fracture of the skull than are men, are a little more apt to die from it. Among one hundred and forty-five cases, twenty-four were females, of whom eleven died, twelve recovered, and one left the hospital on the day of admission (mortality 48 per cent.): of one hundred and twenty-one males, forty-seven (or 39 per cent.) died.

The complications to be feared are mainly infective, such as meningitis, abscess and sinus thrombosis, and need not detain us. A certain amount of inflammatory cedema of the brain and its

membranes occurs in practically all cases and is an occasional cause of death.

So much for the prospect as to mortality. What is the outlook as to completeness of recovery?

In almost all cases certain symptoms of the so-called neurasthenic type last for some time—headache, impairment of memory, vasomotor instability, irritability, a sense of mental and physical exhaustion, and disinclination for exertion. In most cases I think such manifestations are due to real brain injury. These symptoms usually subside in time, though convalescence may take many months.

There are also various permanent disabilities which may be grouped together as due to destruction of brain tissue—aphasia or paraphasia, anosmia, hemiplegia and other paralyses, hemianopia or amblyopia. Mental symptoms occur in cases where the frontal region is affected and range from partial loss of memory to violent insanity or feeble-mindedness.

Finally, there is that considerable group of unfortunate cases where traumatic epilepsy follows the injury. The fits may not appear for some time after the accident.

Brief illustrations of some of these nervous sequelæ of fracture of the skull may be cited from the Western Hospital records.

Persistent neurasthenic symptoms with severe headache, giddiness, depression, and incapacity for mental or physical work lasted two or three years with very little improvement in a brick-layer who fell from a height on his head.

A boy aged fifteen following fractured skull had hemianopia and frequent epileptic fits with some mental deterioration. He had refused operation.

A girl aged seventeen struck by a locomotive had a depressed fracture of the frontal bone. The bone was raised, but the dura was not opened. Normal mentally before the accident, after it she was positively silly, refusing to let anyone "look at her pretty eyes," etc. Her memory too was almost nil. She was unable to find her way about the city alone and several months after the accident failed to remember (after an interval of two weeks) ever having seen the physician in regular attendance upon her.

Doctor Springle's case, already referred to, where extreme laceration of the brain occurred, showed a tendency to loss of self-control, undue suspiciousness and mental deterioration. This young man also took epileptic fits, first beginning some time after

the accident, and had a prolonged series of fits (status epilepticus) which almost ended fatally.

Under the head of prognosis some reference should perhaps be made to the subject of blood pressure. It must be admitted that the information given by the study of blood pressure in fractures of the skull must be interpreted in correlation with other symptoms. But this much may be said: *sudden* changes in blood pressure are to be regarded with suspicion and a sudden or comparatively rapid drop particularly is most ominous and frequently precedes a rapidly fatal termination. Let me quote one illustrative case here.

A very heavily built man, aged fifty-six, fell upon his head a considerable distance to the floor of an ice-house and fractured the base of his skull. Admitted to the Western Hospital at 10.30 he had a blood pressure of 178, which by 10.55 had fallen to 154. The cerebro-spinal fluid contained blood, his breathing was getting more laboured and he was becoming rather cyanosed, but he insisted on delaying somewhat the immediate operation that was strongly advised, until other members of his family could arrive. At 11.20 B.P. was 143; at 11.48 (when operation was begun) B.P. 120; at 11.53 B.P. 115; at 12.00 B.P. 108; at 12.03 B.P. 99; 12.10 B.P. 93; 12.13 B.P. 88; 12.16 B.P. 80; 12.19 B.P. 75. Right up to this time pulse and respirations were practically unchanged, about 120 and 24 respectively. At 12.19 B.P. was 75, pulse became uncountable, and respirations ceased suddenly. Three minutes later, under artificial respiration, B.P. was 60. Artificial respiration was kept up nearly three quarters of an hour to no effect.

The *Treatment* of fractures of the skull is essentially a surgical question, and any suggestions I make along these lines are made with proper diffidence; but my colleagues, Dr. England and Dr. Springle, to whom I wish to express my sincere thanks for permitting me to use the large amount of valuable material from their clinics for the purposes of this paper, have given me such excellent opportunity to follow up all these cases to a termination that even one who is not a surgeon may say this much.

Though every case of fracture of the skull does not require operation, every such case requires the closest observation, for developments that will necessitate immediate operation may take place very rapidly. If operation is decided on, it is of no use whatever to explore the wound without opening the skull, and unless the hæmorrhage is entirely extradural (which seems rather rare), it is of very little use to open the skull without opening the dura.

And, if you wish to decompress, take away enough bone to accomplish your object. A trephine opening an inch across will not afford much room for a compressed brain to expand and the brain is much more apt to be damaged by laceration when the opening is small than when it is of ample size. The patient will not die for the lack of two or three square inches of skull, but he may by keeping too much of his skull lose his life.

Cases are well known in which a fractured limb, to which plaster was immediately applied directly to the skin, later swelled up, became gangrenous and required amputation. Is it not possible that, in cases where considerable inflammatory swelling of the brain and its membranes follows the contusion and laceration caused by the injury, non-interference or half interference may result in somewhat the same effect on the cerebral circulation as the plaster had on the circulation in the rapidly swelling leg, the skull splinting the swollen brain as the plaster did the leg? And remember that any considerable increase of the intracranial over the intraspinal pressure is apt to crush the medulla into the foramen magnum like a tight-fitting cork into a bottle. Also, the medulla, containing as it does all the important vital centres, stands such pressure very badly. I well remember an autopsy on one case of fracture of the skull where this jamming of the medulla into the foramen was present to such an extent that the groove made by the ring of bone pressing on the medulla was distinctly visible.

Apart from the danger to life, I have an impression—it is hardly an opinion for which I could quote you convincing reasons—that on the whole, *cæteris paribus*, cases operated on recover more completely and more rapidly than unoperated cases, and are less likely to have permanent ill-effects, such as epilepsy.

Certainly some cases that for a time apparently do not require operation lapse into such a condition that they must be operated on or die; and occasionally cases occur which one could wish had been operated on, though they were not.

In this connexion, emphasis may be laid upon the frequency with which cases of injury to the cranium supposed to be of a trifling nature have been admitted to the Western Hospital, cases the symptoms of which have become gradually more severe and which would undoubtedly have caused death if operation had not been resorted to in time to save the patient.

One such case that occurred two or three months ago may be briefly quoted. Kept over night in the Out-door department after

a fall, this middle-aged woman was taken to the ward because she hardly seemed well enough to send home. Rather dull and stupid, she was thought to be somewhat lacking mentally, and little attention was paid to her. Her dulness increased, however, and when Dr. England's attention was drawn to her two or three days after her admission, upon his return after an absence from town, she was unable even to tell her own name. When I saw her immediately after, she was not unconscious, though she had incontinence of urine and faeces and nothing that was said to her seemed to reach her understanding. She had, I think, a low blood pressure, and blood-stained cerebro-spinal fluid came away under pressure on lumbar puncture. Operation by Dr. England removed a considerable quantity of dark semi-fluid blood from inside the dura and she made a perfect recovery.

Apart from operative measures, the treatment of fractures of the skull from a neurological standpoint is essentially that of concussion. In this respect it is only necessary to emphasize the importance of complete rest and liquid diet for a sufficiently long time.

THE second convocation of the American College of Physicians will take place at the Hotel Nassau, Long Beach, Long Island, on June 5th, 1917. About ninety per cent. of all the Fellows who have not entered on duties connected with the war are expected to be present. About fifty physicians of national repute will be admitted to Fellowship.

THE honour of being the first woman from the overseas Dominions, and the seventh woman in Great Britain, to pass the first part of the examination for the London degree of F.R.C.S. and L.R.C.P., has fallen to Miss Marian Noel Bostock, daughter of Senator Hewitt Bostock, Liberal leader in the Senate. Miss Bostock at present is acting house physician in the Queen's Hospital for Children at Hackney, London.